Appendix H: Pennsylvania Toxic Emissions Inventory

INTRODUCTION

The Commonwealth of Pennsylvania compiled its statewide air toxic emission inventory for the Great Lakes Air Toxic Emission Inventory Project for calendar year 2002. Pennsylvania conducted its inventory of point source data using its Air Information Management System (AIMS). Mobile source data were calculated by Baker & Associates (Baker) and E.H. Pechan & Associates (Pechan) using MOBILE 6.2 modeling software. Area sources were compiled by Pennsylvania Department of Environmental Protection (DEP) staff and Pechan, using methods set forth in EPA's Emissions Inventory Improvement Program (EIIP). Emissions for area sources were then run through RAPIDS to speciate emissions into their toxic components.

CALCULATION METHODS

Point Source Emissions

Data for point source emissions were collected by the DEP Air Quality staff as part of the annual air emissions inventory process. All major sources of criteria pollutants and Hazardous Air Pollutants, as well as sources subject to New Source Performance Standards, are required to submit data to DEP each year. Data submitted include material throughputs, fuel tests, day and hours of operation, and emissions estimates. Approximately 1,200 facilities submit emissions data. Data are entered into AIMS by DEP and company representatives, after which the system uses AP-42[8] emission factors and control equipment efficiency data to estimate emissions. Staff members compare system estimates with company estimates to determine the more accurate estimation. Company estimates may be based upon such information as stack tests and material balance calculations.

Mobile Source Emissions

Aircraft, Off-Road Mobile, and On-Road Mobile source data were calculated by Baker and Pechan using MOBILE 6.2 modeling software.

Area Source Emissions

Area source emissions were calculated using EIIP methods and speciation profiles contained in RAPIDS. Emission factors used for these included those found in AP-42, and EPA's "Procedures for the Preparation of Emissions Inventories for Carbon Monoxide and Precursors of Ozone"[9]. Activity data used included those derived from census data, *County Business*

[8] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources,* AP-42, Fifth Edition, January 1995.

[9]U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I, General Guidance for Stationary Sources,* EPA-450/4-91-016, May 1991.

Patterns[10] (using NAICS and SIC code queries), U.S. Bureau of Statistics data, Bureau of Labor Statistics[11], Pennsylvania Association of Asphalt Material Applicators figures, and data from the Federal Alcohol and Tobacco Tax and Trade Bureau. A description of the calculation methods, assumptions, and data sources for each area source inventoried follows.

Agricultural Production – Animal Husbandry

Biogenic emission source calculations were derived from EPA's Biogenic Emissions Inventory System (BEIS 2.3)[12] inventory system.

Agricultural Production – Crops (fertilizer application)

Biogenic emission source calculations were derived from EPA's BEIS inventory system.

Architectural Surface Coating

Each county's emissions were calculated using a per capita emission factor and U.S. Bureau of the Census 2002 population data. National solvent- and water-based coating per capita use factors were first calculated from 2002 national paint shipments[13] and 2002 national population data.[14] These factors were then combined with information on the average volatile organic compound (VOC) content of these coatings to calculate per capita emission factors.

Asphalt Paving - Cutback

Annual emissions from cutback asphalt paving were computed from information obtained from the Pennsylvania Association of Asphalt Material Applicators (PAMA)[15] on the amount of cutback asphalt applied in 2002 and the VOC content and density of the asphalt. In addition, it was assumed that 100 percent of cutback asphalt contained diluent and that 70 percent of the diluent evaporates.[16]

Asphalt Paving - Emulsified

Annual emissions from emulsified asphalt paving were computed from information obtained from the Pennsylvania Association of Asphalt Material Applicators[17] on the amount of emulsified asphalt applied in 2002, the VOC content and density of the asphalt, and the percentage of

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[10] U.S. Department of Commerce, Bureau of the Census, *County Business Patterns 2001, Pennsylvania*, available from http://www.census.gov/epcd/cbp/view/cbpview.html. 2003, accessed October 2003.
[11] U.S. Bureau of Labor Statistics, *Current Employment Statistics*, available from http://www.bls.gov/cew/home.htm, accessed November 2003.
[12] http://www.epa.gov/ttnchie1/emch/software/beis/index.html
[13] U.S. Department of Commerce, Bureau of the Census, "Table 2: 2002 Architectural Coating Shipments," *Current Industrial Reports, Paint and Allied Products: 2002*, available from http://www.census.gov/industry/1/ma325f02.pdf), accessed October 2003.
[14] U.S. Department of Commerce, Bureau of the Census, "County Population Estimates Data Sets," available from http://eire.census.gov/popest/estimates_dataset.php, accessed November 2003.
[15] Glen Heilman, Pennsylvania Association of Asphalt Material Applicators, personal communication with Andrea Ramsey, E.H. Pechan & Associates, Inc., February 2004.
[16] Dan Szekeres, Michael Baker Corporation, personal communication with Andy Bollman, E. H. Pechan & Associates, Inc., December 2003.
[17] Glen Heilman, Pennsylvania Association of Asphalt Material Applicators, personal communication with Andrea Ramsey, E.H. Pechan & Associates, Inc., February 2004.

emulsified asphalt containing diluent. In addition, it was assumed that 100 percent of the emulsified asphalt diluent evaporates[18].

Automotive Refinishing

The automotive refinishing VOC emission factor of 2.30 lb/person is based on EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume* I. Population figures were obtained from the U.S. Census Bureau.

Bakeries

VOC emissions were calculated using an employment-based emission factor and the number of NAICS code 311811 and 311812 employees. The Bakeries emission factor is 0.11 tons VOC/employee/year, based upon Radian Corporation's "VOC Emissions from Bakeries".[19] Point source emissions, where present, were subtracted from these emission estimates.

Brake Wear

First, MOBILE6 software was used to calculate the amount of particulate matter (PM) emitted from automotive brake pads for 2002. MOBILE6 is a model for predicting gram-per-mile emissions of certain pollutants from mobile sources. The software calculates emissions by using emission factors associated with Source Classification Codes (SCC) and multiplying them by Vehicle Miles Traveled (VMT).

Speciate Version 3.2 software was then used to calculate emissions of toxic air pollutants, using PM results obtained from MOBILE6. Profile Number 34008 was used for speciating particulate matter from brake wear. Speciate multiplies PM grams per mile by the percentage for each toxic air pollutant, based upon the Profile Number. Results were then converted to tons per year for each toxic.

Breweries

Total Pennsylvania beer production was obtained from the Federal Alcohol and Tobacco Tax and Trade Bureau.[20] The number of brewery (NAICS code 31212) employees in 2002 was estimated by projecting 2001 employment, obtained from the 2001 *County Business Patterns*, to 2002 based on the 2002 to 2001 State-level brewery employment ratio, obtained from the Bureau of Labor Statistics. Emissions were calculated using AP-42 emission factors.

Coal Combustion

Residential coal consumption, in tons per dwelling unit, was estimated using Heating Degree Day (HDD) data, obtained from the National Oceanic and Atmospheric Administration.[21] After

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[18] Dan Szekeres, Michael Baker Corporation, personal communication with Andy Bollman, E. H. Pechan & Associates, Inc., December 2003.

[19] Lucy Adams, Radian Corporation, memorandum to SIP inventory preparers and EPA Regions, "VOC Emissions from Bakeries," prepared under contract to the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (EPA Contract No. 68-D0-0125), April 24, 1992.

[20] Monthly statewide beer production data from Alcohol and Tobacco Tax and Trade Bureau, available from http://www.ttb.gov/alcohol/stats/02stats/02beerstats.htm, accessed December 2003.

[21] National Oceanic and Atmospheric Administration, *Climatological Data: Pennsylvania July-December 2002* (Volume 107, Numbers 07-12), published by National Climatic Data Center, 2003.

estimating residential coal consumption per unit, emissions were calculated by multiplying these values by the number of coal-burning dwelling units and the emission factor for each pollutant.

Year 2002 Commonwealth-level commercial sector coal consumption (computed from the Energy Information Administration's *State Energy Data 2000*[22] and *Annual Coal Report 2002*[23]) Emissions were then calculated by multiplying county coal consumption by the emission factor for each pollutant. Industrial coal-burning emissions were computed in a similar way to commercial/institutional emissions.

In some cases, emission factors differ between anthracite and bituminous coal. Because anthracite is mined in the eastern half of the Commonwealth, while bituminous is mined in the western half, the emission calculations assume that eastern counties burn anthracite coal while western counties burn bituminous coal. For Commercial and Industrial sector categories, point source emissions, where present, were subtracted from these initial emission estimates.

Commercial and Consumer Solvent Use

County-level emissions were calculated using a composite per capita emission factor found in *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I* and U.S. Bureau of the Census population data.

Commercial Cooking

With the exception of deep fat frying of french fries, commercial cooking activity was developed from survey data obtained from a Public Research Institute (PRI) report on charbroiling activity estimation in the State of California.[24] Further details on the annual emission estimation methodology are available in Pechan's 2002 nonpoint source NEI documentation[25].

Composting

Emissions for each county were estimated using a biosolids-generation-based emission factor[26]. Figures on material composted were obtained from *BioCycle's* nationwide survey[27]

Degreasing

22 U.S. Department of Energy, Energy Information Administration, State Energy Data, Pennsylvania, available from www.eia.doe.gov/emeu/states/main_pa.html. 2003, accessed November 2003.

23 U.S. Department of Energy, Energy Information Administration, *Annual Coal Report 2002*, DOE/EIA-0584 (2002), 2003.

24 Public Research Institute, "Charbroiling Activity Estimation, Draft Report," prepared for California Environmental Protection Agency, California Air Resources Board, March 2003.

25 E.H. Pechan & Associates, Inc., "Documentation for the 2002 Nonpoint Source National Emission Inventory for Criteria and Hazardous Air Pollutants," prepared for Emission Factor and Inventory Group, U.S. Environmental Protection Agency, http://www.epa.gov/ttn/chief/net/2002inventory.html, (forthcoming).

26 *Pechan. Estimating Ammonia Emissions from Anthropogenic Sources – Draft Report*

27 BioCycle, 2000. *"2000 BioCycle National Survey – Solid Waste Composting Trends in the U.S."*, BioCycle, November 2000.

Population figures were obtained from the U.S. Census Bureau; emission factors were obtained from EIIP's Volume III[28]. Point source emissions, where present, were subtracted from these emission estimates.

Dry Cleaners

Emissions were estimated using a per capita emission factor obtained from the Pennsylvania Dry Cleaners Association and US Census Bureau population data. The emission factor was determined by DEP using 1990 survey data supplied by the industry. (Contacts with the Pennsylvania and Delaware Cleaners Association indicate that more recent data are not available)[29]. Point source emissions, where present, were subtracted from these emission estimates.

Electrical Appliances

Emissions were estimated using an employment-based emission factor and the number of employees in the NAICS codes, 333414, 335211, 335212, 335221, and 335228. The number of employees in each county for 2001 was obtained from County Business Patterns and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from these emission estimates.

Electrical Insulation

The emissions for each county were calculated using an employment-based emission factor and the number of employees in NAICS codes 331422, 331491, 335311, 335921, and 335929. The number of employees in each county for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.*

Factory Finished Wood

Emissions were calculated using an employment-based emission factor and the number of employees in NAICS codes 32192, 33711, 321211, 321212, 321213, 321911, 321918, 321992, and 321999. The number of employees for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from these emission estimates.

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[28] Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Area Sources, Chapter 5, Consumer and Commercial Solvent Use," prepared for the Area Sources Committee, Emission Inventory Improvement Program, August 1996.

[29] The Pennsylvania Dry Cleaners Association disclosed that 1.8 million pounds of VOCs were emitted in Pennsylvania in 1990 from dry cleaning operations.

Forest Fires

The emissions for each county were calculated using an emission factor from AP-42[30] or the 1999 National Emissions Inventory[31] and a loading factor from AP-42[30]. The number of acres burned was obtained from the Department of Conservation and Natural Resources[32].

Fuel Oil Combustion

Fuel oil emissions were calculated using fuel use estimates derived from Commonwealth consumption estimates from the Energy Information Administration. Population data were obtained from the U.S. Census Bureau. For Commercial sector categories, point source emissions, where present, were subtracted.

Residential Distillate Fuel Oil

The number of dwelling units using distillate oil was obtained from the U.S. Census Bureau.[33] Emission factors per dwelling unit for each pollutant were obtained from AP-42.

Commercial/Institutional Distillate Fuel Oil

The total Commonwealth use was obtained from the Energy Information Administration.[34] Emission factors were obtained from AP-42.

Commercial/Institutional Residual Fuel Oil

The total Commonwealth use was obtained from the Energy Information Administration. Emission factors were obtained from AP-42.

Gasoline Marketing

Bulk terminals and bulk plants are inventoried as point sources. Each category's AP-42 emission factor is based on the average daily throughput that was calculated from monthly data obtained from the Pennsylvania Department of Revenue Bureau of Motor Fuel Taxes. The vehicle miles traveled (VMT), which were obtained from Dan Szekeres of Baker[35], was used to apportion the

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[30] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*, AP-42, Fifth Edition, January 1995.

[31] E.H. Pechan & Associates, Inc., "Documentation for the Draft 1999 National Emissions Inventory (Version 3.0) for Criteria Air Pollutants and Ammonia: Area Sources," prepared for Office of Air Quality Planning and Standards, Emission Factor and Inventory Group, U.S. Environmental Protection Agency, March 2003. Available from ftp://ftp.epa.gov/pub/EmisInventory/draftnei99ver3/criteria/documentation/area/ardoc_99nei_draftv3_0303.pdf, accessed February 2004.

[32] Stan Piorkowski, Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, personal communication with PJ Disclafani, E.H. Pechan & Associates, Inc., December 2003.

[33] U.S. Department of Commerce, Bureau of the Census, "County Population Estimates Data Sets," available from http://eire.census.gov/popest/estimates_dataset.php, accessed November 2003.

[34] U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales, 2002*, available from http://www.eia.doe.gov/oil_gas/petroleum/data_publications/fuel_oil_and_kerosene_sales/foks.html, accessed November 2003.

[35] Dan Szekeres, Michael Baker Corporation, personal communication with Maureen Mullen, E. H. Pechan & Associates, Inc., February 2004.

gasoline throughput to each county. Control efficiency (CE), rule penetration (RP), and rule effectiveness (RE) factors were applied to Stage I for each county to reflect the application of vapor balance systems. A RE factor was applied to Stage II to each regulated county. CE, RP, and RE factors were applied to Underground Storage Tank Breathing to reflect the application of pressure relief valves. There were no point sources for this source category.

Stage II

Vehicle refueling VOC emissions are estimated using MOBILE 6.2-based emission factors;[36] monthly gasoline sales estimates;[37] and county-level, annual vehicle miles traveled (VMT) data. MOBILE 6.2 provided monthly, emission factors for each county in Pennsylvania. MOBILE 6.2 input files were set up to model refueling emission factors in a manner similar to that used for calculating onroad mobile source emissions for 2002.

Graphic Arts

Emissions for each county were calculated using a per capita emission factor and U.S. Census Bureau population data. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I, General Guidance for Stationary Sources.* Point source emissions, where present, were subtracted from these emission estimates.

High Performance Industrial Maintenance Solvent

Emissions were calculated using a per capita emission factor and U.S. Census Bureau population data. Emission factors from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I, General Guidance for Stationary Sources* were used.

Kerosene

Emissions were calculated using emission factors and Energy Information Administration fuel use information.

Residential Kerosene

The number of dwelling units using kerosene was obtained from the U.S. Census Bureau. Emission factors per dwelling unit for each pollutant were obtained from EPA's "*Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion*".[38]

Commercial/Institutional Kerosene

[36] U.S. Environmental Protection Agency, "User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model," EPA420-R-02-028, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, October 2002.

[37] Pennsylvania Department of Revenue, Bureau of Motor Fuel Taxes, "Monthly Report of Gallons" for 2002, provided by Paul Sload, December 2003.

[38] [38] Pacific Environmental Services, Inc., "Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion," prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, September 2002.

Total Commercial/Institutional kerosene consumption in the Commonwealth was obtained from the Energy Information Administration. The emission factors used for Commercial/ Institutional Kerosene were taken from EPA's "*Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants"*[39].

Landfills

The emissions were calculated using the total amount of refuse in Pennsylvania's municipal solid waste landfills, not the landfills' capacity. Since landfills continue to emit VOCs long after they are closed (at least 20 years), data from active and inactive landfills were collected. For active landfills, data from page two of the 2002 "Annual Facility Capacity Report" for each landfill were collected. In particular, Total Waste Accepted was needed for the final emissions calculation. The emissions estimate was adjusted for precipitation.

Several landfills that were included in the 1996 Pennsylvania area source inventory were not included in the compilation of 2002 facility reports provided by PA DEP. After confirming with PA DEP that these landfills are inactive (in a few cases the landfills had merely been renamed), the 1996 Total Waste Accepted data for these now-closed landfills were incorporated into the 2002 inventory.

Machinery and Equipment

Emissions were calculated using an employment-based emission factor and employee data from NAICS Codes 333 (except 333314 and 333315), 33271, 332991, 332997, 3341, and 336391. The number of employees for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from emission estimates.

Marine Coating

Emissions were calculated using an employment-based emission factor and employee data from NAICS code 33661. The number of employees for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from emission estimates.

Metal Cans

Emissions were calculated using an employment-based emission factor and employee data from NAICS Codes 332431 and 332439. The number of employees for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth

[39] Eastern Research Group, Inc., "Documentation for the 1999 Base Year Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants," U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factor and Inventory Group, September 30, 2002.

employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from emission estimates.

Metal Furniture and Fixtures

Emissions were calculated using an employment-based emission factor and employee data for NAICS codes 337121, 337124, 337214, and 337215. The number of employees for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from emission estimates.

Miscellaneous Finished Metal

Emissions were calculated using an employment-based emission factor and employee data from NAICS Codes 332812, 339911, 339912, and 339914. The number of employees was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from these emission estimates.

Miscellaneous Manufacturing

Emissions for each county were calculated using a per capita emission factor and U.S. Census Bureau population data. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from these emission estimates.

Natural Gas and Liquefied Petroleum (LPG)

Area source natural gas and LPG emissions were estimated using fuel consumption data and AP-42 emission factors. Consumption data were apportioned according to the number of dwelling units heating with natural gas/LPG, which was available from U.S. Census Bureau data (for residential sources), and according to the number of commercial sector facilities, obtained from County Business Patterns (for commercial/institutional sources). Commercial and Residential LPG consumption was not available for 2002; therefore, the 2001 consumption was grown to 2002 by applying the ratio of 2002 Commercial/Residential propane sales in Pennsylvania to 2001 Commercial/ Residential propane sales in the Commonwealth. Commercial LPG consumption in 2001 was obtained from the Energy Information Administration's *State Energy Data 2001*. Propane sales for 2001 and 2002 were obtained from *Petroleum Marketing Annual*.[40,41] Commercial sector point sources, where present, were subtracted.

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[40] U.S. Department of Energy, Energy Information Administration, *Petroleum Marketing Annual 2001*, available from http://tonto.eia.doe.gov/FTPROOT/petroleum/048701.pdf, accessed November 2003.
[41] U.S. Department of Energy, Energy Information Administration, *Petroleum Marketing Annual 2002*, available from http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_marketing_annual/pma.html, accessed November 2003.

Open Burning

Criteria pollutant annual emissions associated with three of the Residential Open Burning categories (i.e., MSW, Leaf, and Brush) were compiled from an inventory prepared for the Mid-Atlantic/Northeast Visibility Union (MANE-VU).[42] Annual emission estimates for Commercial/ Institutional and Industrial Open Burning were calculated in this project using AP-42 emission factors and population and employment based emission activity loading factors.

U.S. Census Bureau population data were used in the Residential and Commercial/Institutional calculations, while the number of Manufacturing employees (NAICS 31-33) was used for the Industrial category. The 2001 Manufacturing sector employment data from County Business Patterns was grown to 2002 using the ratio of the 2002 Pennsylvania Manufacturing sector employment to the 2001 Pennsylvania Manufacturing sector employment obtained from the Bureau of Labor Statistics.

Organometallic Brake Dust:

Calculations for these emissions were similar to those used for Brake Wear. However, Profile Number 34007 was used, rather than 34008.

Other Special Purpose Coating

Emissions for this category were estimated using a per capita emission factor and U.S. Bureau of the Census population data. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.*

Other Transportation

Emissions were calculated using an employment-based emission factor and employee data from NAICS Codes 33633, 33634, 33635, 333924, 336312, 336322, 336399, 336411, 336413, and 33651. The number of employees in each county for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio or 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point source emissions, where present, were subtracted from these emission estimates.

Pesticide Application

Emissions were estimated using an emission factor based on the number of harvested acres. Harvested acreage data were obtained from the U.S. Department of Agriculture's National Agricultural Statistics Service.[43] Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.*

Portable Gasoline Containers

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[42] E.H. Pechan & Associates, Inc., "Open Burning in Residential Areas, Emissions Inventory Development Report," prepared for Mid-Atlantic/Northeast Visibility Union, January 31, 2004.
[43] U.S. Department of Agriculture, National Agricultural Statistics Service, "Agricultural Statistics Database, Crops County Data," available from http://www.nass.usda.gov:81/ipedb/, accessed October 2003.

Gasoline throughput for 2002 was estimated based on gas container population and use data obtained from a California Air Resources Board survey.[44] The year 2002 residential container population was estimated from the county-level number of occupied housing units.[45] For counties for which 2002 occupied housing units data were not available, 2000 year housing units data[46] were projected to 2002 based on county population growth rates.[14] The year 2002 commercial container population was estimated from the number of commercial sector businesses.[47] County-level nonroad equipment gasoline consumption estimates were obtained from the NONROAD model.[48]

County-level year 2002 housing unit, commercial facility, and gasoline throughput data were then used in the emission calculation procedures described in *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules.*[49] For the permeation, diurnal, and transport emission processes, these procedures result in daily emission estimates for both residential and commercial. These emissions were converted to annual emissions by multiplying by 214 days based on the assumption that nonroad equipment is fueled via gas containers primarily between April and October. The resulting annual emission estimates were then added to the spillage and vapor displacement annual emissions estimates, which were developed from annual NONROAD model gasoline consumption data, to yield total portable gasoline container annual emissions for each county.

Publicly Owned Treatment Works

Annual NH_3 emission estimates were taken from an on-going Mid-Atlantic/Northeast Visibility Union (MANE-VU) inventory development project. As part of this Pennsylvania inventory effort, annual emissions were estimated for the POTW Wastewater Treatment Processes category using the MANE-VU project Pennsylvania emission activity data (total POTW flow) and an AP-42 sewage treatment emission factor.

Year 2000 POTW flow data for Pennsylvania facilities were obtained from the EPA Office of Wastewater Management's year 2000 Clean Watersheds Needs Survey.[50] Year 2002 wastewater flow was estimated from the county population change between 2000 and 2002.[14] Year 2000

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[44] California Air Resources Board, *Public Meeting to Consider Approval of California's Portable Gasoline-Container Emissions Inventory*, September 1999.
[45] U.S. Bureau of the Census, *2002 American Community Survey*, available from http://www.census.gov/acs/www/Products/Profiles/Single/2002/ACS/PA.htm, accessed February 2004.
[46] U.S. Bureau of the Census, *Census 2000*, available from http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=04000US42&-_box_head_nbr=GCT-H6&-ds_name=DEC_2000_SF1_U&-_lang=en&-redoLog=false&-format=ST-2&-mt_name=DEC_2000_SF1_U_GCTH6_US9&-_sse=on, accessed February 2004.
[47] Dun & Bradstreet, Inc., *MarketPlace* CD-ROM, Jan.-Mar., 2002, April 2002.
[48] U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Draft NONROAD2002a, [Computer software]. Available June 16, 2003 at http://www.epa.gov/otaq/nonroadmdl.htm.
[49] E.H. Pechan & Associates, Inc., *Control Measure Development Support Analysis of Ozone Transport Commission Model Rules*, prepared for the Ozone Transport Commission, March 2001.
[50] U.S. Environmental Protection Agency, "Clean Watersheds Needs Survey 2000," Office of Wastewater Management, available from http://cfpub.epa.gov/cwns/, accessed December 2003.

statewide biosolids generation was obtained from *BioCycle 2000*.[51] Facility-level biosolids production was estimated based on allocating State generation using facility-level wastewater flow rates. Year 2002 biosolids generation was estimated by applying Bureau of Census county population growth rates to year 2000 generation. Land application of total biosolids generation was calculated by multiplying total generation by 55 percent, which represents the percentage of total Pennsylvania biosolids generation applied to land.[51] Where present, point source emissions were subtracted from the emissions of the corresponding county.

Refrigerant Loss

Emissions were estimated using an employment-based emission factor formulated by Pechan[52, 53] and the number of employees in the following NAICS codes: 311611, 311612, 311613, 311615, 311512-311514, 31152, 311411, 311412, 311421-311423, 31181, 31132, 31133, 31211-31213, 31171, 312113, 311991, 311999, 325211, 49312, 311612, 42281, 42282. The number of employees in each county was obtained from *County Business Patterns*[54] and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.* Point Sources, where present, were subtracted from the emissions estimate.

Residential Wood Combustion

Criteria pollutant annual emissions associated with residential heating with wood were compiled from the 2002 nonpoint source National Emissions Inventory (NEI). The 2002 NEI reports residential wood combustion emissions in seven SCCs, each of which represents a specific combustion equipment type. The NEI residential wood combustion emission estimation methodology is based on the national population of each equipment type and an estimate of the amount of wood burned in each type of equipment. Residential wood combustion emission factors were obtained from EPA's AP-42 document.

Disclaimer:
Pennsylvania is in the process of reexamining methodology, raw data, emission numbers, and hazardous air pollutant speciation for Residential Wood Combustion/Woodstoves, SCC numbers 2104008010 and 2104008050. Upon confirmation or correction of these data, Pennsylvania will notify Great Lakes Commission, and the corrected numbers or confirmation will be posted on the Great Lakes Commission website.

[51] JG Press, Inc. "2000 Biocycle National Survey – Solid Waste Composting Trends in the U.S." *BioCycle, Vol. 41 Issue 11*, November 2000.
[52] Pechan. *Estimating Ammonia Emissions from Anthropogenic Sources – Draft Report.* Prepared for the US EPA, Emissions Inventory Improvement Program, prepared by E.H.Pechan & Associates, Inc. March 2004.
[53] Pechan. Technical Memorandum: MANE-VU 2002 Ammonia Emissions Inventory for Miscellaneous Sources – Final, prepared for MARAMA by E.H. Pechan & Associates, Inc. March 2004.
[54] U.S. Department of Commerce, Bureau of the Census, County Business Patterns 2001, Pennsylvania, available from http://www.census.gov/epcd/cbp/view/cbpview.html. 2003, accessed October 2003.

Solid Waste Incineration

Emissions were estimated using emission factors and loading factors from AP-42, population data from the U.S. Census Bureau, and employee data from *County Business Patterns*. Point source emissions, where present, were subtracted from these emission estimates.

Structure Fires

Structure fire emissions were estimated using emission factors, a loading factor, and a default number of fires per capita. Population data were obtained from the U.S. Census Bureau. Emission factors were obtained from EPA's *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I.*

Traffic Line Painting

Each county's emissions were calculated per "Alternative Method III" [55] described in the EIIP emission estimation guidance document for this category. The calculation uses a national per capita emission factor based on 2002 data for national traffic paint consumption and U.S. population.

Wineries

Emissions were determined using 2002 county-level wine production data provided by the Pennsylvania Liquor Control Board (PLCB).[56] Emission factors for both red and white wines were obtained from AP-42. Since the emission factors for the two types of wines are different, but wine type production data are no longer available, wine production in the Commonwealth was assumed to be 60 percent white wine and 40 percent red wine.[57] Point source emissions, where present, were subtracted from emission estimates.

Wood Furnace Manufacturing

Each county's emissions were calculated using a per-employee emission factor[58] and the number of employees in NAICS codes 337122, 337127, 337129, 337211, and 337212. The number of employees in each county for 2001 was obtained from *County Business Patterns* and grown to 2002 using the ratio of 2002 total Commonwealth employees to 2001 total Commonwealth employees obtained from the Bureau of Labor Statistics. A 30 percent reduction in VOC emissions was assumed based on a RACT-based regulation.[59] Point source emissions, where present, were subtracted from these emission estimates.

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[55] Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Area Sources, Chapter 14, Traffic Markings" prepared for Area Sources Committee, Emission Inventory Improvement Program, May 1997.

[56] Susan Rose, Office of Planning and Policy Management, Pennsylvania Liquor Control Board, personal communication with PJ Disclafani, E.H. Pechan & Associates, Inc., December 2003.

[57] Pennsylvania Liquor Control Board figures showing Pennsylvania wine production in 1990.

[58] "Short List" of AMS SCCs and Emission Factors. July 1992.

[59] 30 Pa.B 2995, 2000: *Pennsylvania Bulletin*, "Surface Coating Processes," Volume 30, Number 24, Harrisburg, PA, June 10, 2000.

Pennsylvania – State Emission Totals (lbs/yr)

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Acenaphthene (83-32-9)	5493	1722	1784		8998
Acenaphthylene (208-96-8)	12,850	5638	9567		28,050
Acetaldehyde (75-07-0)	61,200	1,009,000	1,457,000	86,220	2,613,000
Acetonitrile (75-05-8)	2238			20,180	22,420
Acetophenone (98-86-2)	453			207	660
Acrolein (107-02-8)	2486	99,310	207,900	15,550	325,200
Acrylamide (79-06-1)				1	1
Acrylic acid (79-10-7)				402	402
Acrylonitrile (107-13-1)	2503			2830	5332
Allyl chloride (107-05-1)	125.4				125.4
Aniline (62-53-3)				203	203
Anthracene (120-12-7)	2111	1333	2135		5579
Antimony (7440-36-0)	9.29			3017	3026
Arsenic (7440-38-2)	3603		10.57	21,410	25,030
Benz(a)anthracene (56-55-3)	2306	345.3	474.2		3126
Benzo(g,h,i)perylene (191-24-2)	2080	792.8	622.5	5312	8807
Benzene (71-43-2)	5,849,000	4,175,000	10,240,000	252,900	20,510,000
Benzo(a)pyrene (50-32-8)	2162	267.9	303.2	1921	4654
Benzo(b)fluoranthene (205-99-2)	2471	233.7	336.9		3041
Benzo(k)fluoranthene (207-08-9)	1160	221.4	336.9		1718
Benzyl chloride (100-44-7)	52.63			4062	4114
Beryllium	107.4	25.66		657.4	790.5
Biphenyl (92-52-4)	6200			2527	8727
Bis(2-chloroethyl)ether (111-44-4)				240	240
Bromoform (75-25-2)				18	18
Methyl bromide (74-83-9)				1674	1674
1,3-Butadiene (106-99-0)	982	567,100	1,418,000	12,870	1,999,000
Cadmium	537.1	33.9		28,790	29,360
Carbon disulfide (75-15-0)	28,030			66,490	94,520
Carbon tetrachloride (56-23-5)	7314			9411	16,720
Carbonyl sulfide (463-58-1)				857,600	857,600

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Catechol (120-80-9)				200	200
Chlorine (7782-50-5)			2028	160,400	162,400
Chloroacetic acid (79-11-8)				60	60
Chlorobenzene (108-90-7)	3486			11.4	3497
Chloroethane (75-00-3)	112,000			1536	113,500
Chloroform (67-66-3)	41,780			29,610	71,390
2-Chloro-1,3-butadiene (126-99-8)	153.8			1920	2074
Chromium	2307	53.54	2039	122,000	126,400
Chromium VI (18540-29-9)		30.23	421.6	19.2	471
Chrysene (218-01-9)	2401	248	267.3		2916
2-Chloroacetophenone (532-27-4)				93	93
Coke oven emissions				241,500	241,500
Copper (7440-50-8)			643.5		643.5
Cresol (mixed isomers) (1319-77-3)				19,540	19,540
O-Cresol (95-48-7)	293.5			20	313.5
P-Cresol (106-44-5)	594.2				594.2
Cumene (98-82-8)	28,650			92,800	121,500
Cyanide				67,120	67,120
Dibenz(a,h)anthracene (53-70-3)	271.4	5.104	0.2086		276.7
Dibenzofuran (132-64-9)				3032	3032
Di-N-butyl phthalate (84-74-2)	950.3			4577	5528
1,2-Dichloroethane (107-06-2)	2993			1197	4189
1,4-Dichlorobenzene (106-46-7)	1529			240.8	1769
1,1-Dichloroethane (75-34-3)				2465	2465
Diethyl sulfate (64-67-5)				20	20
Diethanolamine (111-42-2)				1820	1820
Dimethyl phthalate (131-11-3)	307.8			980	1288
Dimethyl sulfate (77-78-1)	8.222			262	270.2
N,N-Dimethylformamide (68-12-2)	99,250			3064	102,300
Dimethylanaline (121-69-7)	2089				2089
2,4-Dinitrotoluene (121-14-2)	311.7				311.7
Diethylhexyl phthalate (117-81-7)	923.9			6215	7139

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
1,4-Dioxane (123-91-1)				4550	4550
Epichlorohydrin (106-89-8)	28.96			160.3	189.3
1,2-Epoxybutane (106-88-7)				3292	3292
Ethyl acrylate (140-88-5)	11.02			7080	7091
Ethyl benzene (100-41-4)	252,600	2,878,000	4,317,000	411,200	7,859,000
Ethylene glycol (107-21-1)	4,826,000			103,600	4,930,000
Ethylene oxide (75-21-8)	1439			2661	4099
Fluoranthene (206-44-0)	5481	2374	2223		10,080
Fluorene (86-73-7)	4224	3595	3730		11,550
Formaldehyde (50-00-0)	96,410	2,535,000	4,412,000	706,000	7,749,000
Glycol ethers	1,778,000			837,900	2,616,000
Hydrochloric acid (7647-01-0)	10,120,000			56,860,000	66,980,000
Hexachlorocyclopentadiene (77-47-4)	3.456				3.456
Hexamethylene-1,6-diisocyanate (822-06-0)				449.8	449.8
Hexane (110-54-3)	893,100	1,951,000	3,786,000	229,300	6,859,000
Hexachloro-1,3-butadiene (87-68-3)	4.415				4.415
Hexachlorobenzene (118-74-1)	18.06			200	218.1
Hydrogen fluoride (7664-39-3)	1,235,000			6,080,000	7,315,000
Hydrogen cyanide (74-90-8)	390,500				390,500
Hydroquinone (123-31-9)				400	400
Indeno(1,2,3-c,d)pyrene (193-39-5)	1829	240	171		2240
Isophorone (78-59-1)				60,320	60,320
Lead	15,340	7556	123.6	120,900	143,900
Alkylated lead (78-00-2)	9.7				9.7
Maleic anhydride (108-31-6)				122	122
Manganese (7439-96-5)	333.2	100.1	2376	67,680	70,490
Mercury (7439-97-6)	158.6			6169	6327
Methyl ethyl ketone (78-93-3)	8,786,000	7435		1,545,000	10,340,000
Methyl hydrazine (60-34-4)				79	79
Methyl iodide (74-88-4)				82.8	82.8
Methyl isobutyl ketone (108-10-1)	6,522,000			951,300	7,473,000
Methyl methacrylate (80-62-6)	5711			91,340	97,050

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
Methyl tert-butyl ether (1634-04-4)	1,485,000	4,388,000	4,043,000	104,700	10,020,000
Methanol (67-56-1)	7,284,000			1,308,000	8,593,000
4,4'-Methylenediphenyl diisocyanate (101-68-8)	4313			8424	12,740
4,4'-Methylenedianaline (101-77-9)				1738	1738
Methyl chloride (74-87-3)	93,300			8473	101,800
Methylene chloride (dichloromethane) (75-09-2)	243,100			896,100	1,139,000
Naphthalene (91-20-3)	94,210	104,100	253,000	102,500	553,900
Nickel	1361	1936	1582	76,880	81,760
Nitrobenzene (98-95-3)	42.22			2	44.22
4-Nitrophenol (100-02-7)	952.9				952.9
2-Nitropropane (79-46-9)	1.698				1.698
Polychlorinated biphenyls (PCBs) (1336-36-3)	2386				2386
Pentachlorophenol (87-86-5)	43.93				43.93
Tetrachloroethylene (Perc) (127-18-4)	29,500			108,500	138,000
Phenanthrene (85-01-8)	10,280	6561	6156	349.2	23,350
Phenol (108-95-2)	219,600	1094		305,400	526,100
P-Phenylenediamine (106-50-3)				16	16
Phosphorus (7723-14-0)				4958	4958
Phthalic anhydride (85-44-9)				414.6	414.6
Polychlorinated dibenzodioxins, total		0.06534	0.1706		0.2359
Polychlorinated dibenzofurans, total		0.0119	0.0354		0.0473
Propionaldehyde (123-38-6)	14,820	241,200	235,200	12,800	504,100
Propylene dichloride (78-87-5)	74.37			2.2	76.57
Propylene oxide (75-56-9)	4747			465	5212
Pyrene (129-00-0)	5283	2760	3097		11,140
Quinoline (91-22-5)				1378	1378
Quinone (106-51-4)				60.8	60.8
Selenium (7782-49-2)	752.8	15.54	29.59	60,660	61,460
Styrene (100-42-5)	791,800	160,900	849,100	1,186,000	2,988,000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (1746-01-6)		0.000393	0.001133		0.001526
2,3,7,8-Tetrachlorodibenzofuran (51207-31-9)		0.001006	0.002998		0.004004
1,1,1-Trichloroethane (71-55-6)	1,349,000			41,900	1,391,000

Pollutant Name (CAS)	Area Source Emissions	Non-road Emissions	On-road Emissions	Point Source Emissions	Total Emissions
1,1,2,2-Tetrachloroethane (79-34-5)	11.02			882.6	893.6
Toluene (108-88-3)	6,156,000	13,940,000	28,990,000	2,590,000	51,670,000
Toluene-2,4-diisocyanate (584-84-9)	615.9			1868	2484
O-Toluidine (95-53-4)	11.02				11.02
Trichloroethylene (79-01-6)	411,000			1,153,000	1,564,000
1,2,4-Trichlorobenzene (120-82-1)	650.9			4102	4753
1,1,2-Trichloroethane (79-00-5)	7.229			880	887.2
Triethylamine (121-44-8)	1848			95,300	97,140
2,2,4-Trimethylpentane (540-84-1)	462,100	5,510,000	10,560,000	7534	16,540,000
Vinylidene chloride (75-35-4)	2743				2743
Vinyl acetate (108-05-4)	4193			88,510	92,700
Vinyl chloride (75-01-4)	43.19			88,790	88,840
M-Xylene (108-38-3)				2874	2874
O-Xylene (95-47-6)	6057			6843	12,900
P-Xylene (106-42-3)				0.6	0.6
Xylene (mixed isomers) (1330-20-7)	4,186,000	11,940,000	16,380,000	1,746,000	34,250,000